

towards shallow water areas from offshore waters for feeding. According to Rao and Basheeruddin (1973), migration may also be for spawning. The observed specimens of this species were in mature condition. Though flying fishes may show stray occurrences throughout the year, the period of abundance is during post monsoon. In May 2007, the sea was very turbulent off Mumbai. Turbulence generally results in transport of nutrients from deeper waters, inducing increased planktonic productivity, and hence increased abundance of zooplankton on which flying fish feed (Oxenford *et al.* 1995). This phenomenon could have led to the occurrence of this species during this period in Mumbai waters in such large numbers.

According to Parin (1996), flying fishes are objects of fisheries that are fished in many tropical countries, and practical requirements of fishery demand the knowledge of the species composition of this group in certain regions. Regional distribution and relative abundance of flying fishes have not

been studied extensively along the Indian coast, and therefore efforts need to be taken in this direction and also regarding the commercial exploitation of these fishes. A specimen of *C. abei* has been deposited in the Reference Collection Museum of Central Marine Fisheries Research Institute, Kochi.

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REFERENCES

- ARORA, H.L. & S.K. BANERJI (1957): Flying fish fishery along the Coromandel coast. *Indian J. Fish* 4(1): 80-91.
- BRUUN, A.F. (1935): Flying-fishes (Exocoetidae) of the Atlantic-Systematic and Biological studies. *Dana Report* 2(6): 1-106.
- CMFRI (1995): A manual for standardised linear measurements of exploited finfish and shellfish. *CMFRI Sp. Pub.* 78 pp.
- DAY, F. (1877): The Fishes of India. Bernard Quaritch, London Part 3: 369-552.
- DAY, F. (1889): The Fauna of British India, including Ceylon and Burma. Taylor and Francis. London. Vol. 1. 548 pp.
- GIBBS, R.H. JR. (1981): Exocoetidae, flying fishes. In: Fischer, W., G. Bianchi & W.B. Scott (Eds): FAO species identification sheets for fishery purpose. *Eastern Central Atlantic, fishing area* 34, 47 (in part), Vol 2. Var. Canada finds-in-trust, Ottawa. Department of fisheries and Oceans, Canada, by arrangement with FAO of the UN.
- HERALD, E.S. (1969): Living Fishes of the World. Chanticleer Press, New York. 304 pp.
- HORNELL, J. (1923): The flying fish fishery of the Coromandel coast and the spawning habits of *Cypsilurus*. *Madras Fish Bull.* 15: 99-108.
- KAMBLE, S.K., S. SUNDARAM, M.P. SREERAM & J.D. SARANG (2007): Record of three species of flying fish from Mumbai Waters. *Mar. Fish. Infor. Serv., T and E ser.* No. 194: 19-20.
- KIZHAKUDAN, J.K., J.K. SHOBA, V.D. SAVARIA, J.D. VANVI, A.A. LADANI, J.P. POLARA & A.P. BHARANDA (2002): Unusual landings of flying fish, *Cheliopogon furcatus* (Mitchill, 1815) in Veraval, Mangrol and Chorward. *Mar. Fish. Infor. Serv. T and E ser.* No.171: 10.
- OXENFORD, H.A., R. MOHON & W. HUNTE (1995): Distribution and relative abundance of flying fish (Exocoetidae) in the eastern Caribbean. I. *Adults. Mar. Ecol. Prog. Ser.* 117: 11-23.
- PAJOT, G. & C.R. PRABHAKARADU (1993): Flying fish fishing on the Coromandel coast, 1988-1991. *BOBP/WP/84*, Bay of Bengal Programme. Project Report. Madras. 21 pp.
- PARIN, N.V. (1960): Flying fish (Exocoetidae) of the north-western part of the Pacific Ocean. *Tr. Inst. Okean. Akad. Nauk SSSR* 31: 205-285.
- PARIN, N.V. (1961): On the Exocoetid fauna of the Pacific and Indian Oceans. *Trudy Inst. Okeanol.* 43: 40-92.
- PARIN, N.V. (1968): Ichthyofauna of the epipelagic zone. *Israel Program. Sci. Transl.*
- PARIN, N.V. (1996): On the species composition of flying fishes (Exocoetidae) in the West-Central part of tropical Pacific. *J. Ichthyol.* 36(5): 357-364.
- RAO, K.S. & S. BASHEERUDDIN (1973): Unusual catches of the flying fish, *Parexocoetus brachypterus brachypterus* (Richardson) in inshore waters at Madras. *Indian J. Fish.* 20(2): 629-634.
- SUNDARAM, S. & J.D. SARANG (2003): Stray landing of flying fish *Cheliopogon furcatus* (Mitchill, 1815) at New Ferry Wharf, Mumbai. *Mar. Fish. Infor. Serv., T and E ser.* No.175: 12.
- VIJAYARAGAVAN, P. (1973): Studies on fish eggs and larvae from Indian waters. I. Development of egg and larvae of *Hirundichthys (Hirundichthys) coromandelensis* (Hornell). *Indian J. Fish.* 20(1): 108-137.

13. BEE PASTURAGE PLANTS OF *APIS FLOREA* IN KHAMMAM REVENUE DIVISION, KHAMMAM DISTRICT, ANDHRA PRADESH, INDIA

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Introduction

Melissopalynology, one of the branches of palynology finds a very significant application in the field of apiculture.

A qualitative and quantitative pollen analysis of honey provides the only means of identifying the bee pasturage plants in any locality (Kalpana TP, Ramanujam CGK-1996A).

The present study is carried out to reveal the bee pasturage plants of *Apis florea* in Khammam district.

Material and Methods

Seven winter honey samples were collected from Lakshmipuram (Mudigonda mandal), Khammam (Khammam rural mandal), Nelapatla (Kusumanchi mandal), Chirunomula (Bonkal mandal), Nelakondapalli (Nelakondapalli mandal), Konegudem (Nelakondapalli mandal), and Rejerla (Viamsur mandal). The methodology recommended by the International Commission of Bee Botany (Louveaux *et al.* 1978) was employed for the recovery of pollen contents and their analysis. 1 ml of honey was dissolved in 10 ml of distilled water, centrifuged, and subjected to acetolysis (Erdtman 1960). Three pollen slides were prepared from each honey sample and the pollen types were identified with the help of reference slide collections of local flora and relevant literature.

Observations

Of the seven honey samples (Table 1), two samples (N-N-K-5 and V-R-K-7) were unifloral and predominant with *Prosopis juliflora* (90.5%) and *Xanthium strumarium* (56%). Remaining five samples were multifloral, having the pollen taxa of *Psidium guajava*, *Capsicum frutescens*, *Phoenix sylvestris*, *Prosopis spicigera*, *Borassus flabellifer*, *Holoptelea integrifolia*, *Croton bonplandianum*, *Dendrophthoe falcata*, *Ageratum conyzoides*, *Ricinus communis*, *Peltophorum ferrugineum*, *Sapindus emarginatus*, *Coccinea grandis*,

Table 1: Honey samples collected from Khammam revenue division

S.No	Date	Mandal	Village	Code	Colour
1	03.i.2005	Mudigonda	Lakshmipuram	M-L-K	Amber
2	12.i.2005	Khammam	Khammam Rural	K-K-K	Yellow
3	14.x.2005	Kusumanchi	Nelapatla	K-N-K	Amber
4	27.xii.2005	Bonakal	Chirunomula	B-C-K	Amber
5 *	16.xii.2006	Nelakondapalli	Nelakondapalli	N-N-K	Yellow
6	22.xi.2005	Nelakondapalli	Konegudem	N-K-K	Amber
7 *	18.x.2006	Viamsur	Rajerla	V-R-K	Yellow

*: Unifloral honeys

Eucalyptus globulus, *Cocos nucifera*, *Cajanus cajan*, *Tridax procumbens*, *Citrus aurantifolia*, *Leucaena leucocephala*, *Ziziphus mauritiana*, *Justicia procumbens*, *Alternanthera sessilis* and *Tridax procumbens* among others (Table 2).

Discussion

Bee pasturage plants of *Apis florea* in Khammam revenue division are referred to 3 categories 1) Trees - *Prosopis juliflora*, *Psidium guajava*, *Phoenix sylvestris*, *Prosopis spicigera*, *Borassus flabellifer*, *Holoptelea integrifolia*, *Peltophorum pterocarpum*, *Sapindus emarginatus*, *Muntingia calabura*, *Ziziphus mauritiana*, *Leucaena leucocephala*, *Eucalyptus globulus*, *Cocos nucifera*, *Citrus aurantifolia*, *Bombax ceiba*, 2) Shrubs - *Ricinus communis*, *Cajanus cajan*, *Xanthium strumarium*

Table 2: Frequency classes and frequencies (%) of pollen types recorded from honey samples

Honey sample	Pollen types	Bee pasturage plants of <i>Apis florea</i> and frequencies (%) of pollen types
M-L-K-1	P-	NIL
	S-	<i>Psidium guajava</i> -30.6%, <i>Capsicum frutescens</i> -25.6%
	I-	<i>Phoenix sylvestris</i> -11.33%, <i>Prosopis juliflora</i> -10.86%, <i>Prosopis spicigera</i> -5.4%, <i>Borassus flabellifer</i> -4.58%, <i>Holoptelea integrifolia</i> -4.16%
	M-	<i>Croton bonplandianum</i> -2.9%, <i>Amaranthus viridis</i> -2.5%, <i>Ageratum conyzoides</i> -0.83%, <i>Celosia argentea</i> -0.16%, <i>Cocos nucifera</i> -0.5%, <i>Imperata cylindrica</i> -0.08%
K-K-K-2	P-	NIL
	S-	<i>Prosopis juliflora</i> -25%, <i>Celastrus emarginatus</i> -21.6%
	I-	<i>Ageratum conyzoides</i> -15%, <i>Ricinus communis</i> -8.3%, <i>Peltophorum pterocarpum</i> -6.6%, <i>Sapindus emarginatus</i> -4.6%, <i>Coccinia grandis</i> -4.33%, <i>Muntingia calabura</i> -3.33%, <i>Phoenix sylvestris</i> -3%
	M-	<i>Sida acuta</i> -2.6%, <i>Alternanthera sessilis</i> -1%, <i>Bombax ceiba</i> -0.6%
K-N-K-3	P-	NIL
	S-	<i>Borassus flabellifer</i> -37%, <i>Prosopis juliflora</i> -33.75%
	I-	<i>Eucalyptus globulus</i> -14.33%, <i>Phoenix sylvestris</i> -10.83%, <i>Cocos nucifera</i> -3.5%
	M-	Asteraceae-0.16%

Table 2: Frequency classes and frequencies (%) of pollen types recorded from honey samples (contd.)

Honey sample	Pollen types	Bee pasturage plants of <i>Apis florea</i> and frequencies (%) of pollen types
B-C-K-4	P-	NIL
	S-	<i>Cajanus cajan</i> -30.25%, <i>Prosopis juliflora</i> -28.16%, <i>Capsicum frutescens</i> -22.33%
	I-	Poaceae-4.16%, <i>Achyranthes aspera</i> -3.6%, <i>Tridax procumbens</i> -3.3%
	M-	<i>Ageratum conyzoides</i> -2.3%, <i>Justicia procumbens</i> -2.9%, <i>Sapindus emarginatus</i> -1%, <i>Vernonia cinerea</i> -0.16%, <i>Leucaena leucocephala</i> -0.6%, <i>Cocos nucifera</i> -0.5%, <i>Celosia argentea</i> -0.5%
N-N-K-5	P-	<i>Prosopis juliflora</i> -90.5%
	S-	NIL
	I-	<i>Cajanus cajan</i> -3%, <i>Citrus aurantifolia</i> -3%
	M-	<i>Evolvulus alsinoides</i> -1.75%, <i>Ageratum conyzoides</i> -1.75%
N-K-K-6	P-	NIL
	S-	<i>Prosopis juliflora</i> -25%, <i>Ageratum conyzoides</i> -24.83%
	I-	<i>Leucaena leucocephala</i> -14%, <i>Ziziphus mauritiana</i> -12.83%, <i>Justicia procumbens</i> -12.5%, <i>Citrus aurantifolia</i> -3.6%
	M-	<i>Evolvulus alsinoides</i> -0.16%, <i>Cocos nucifera</i> -0.5%, <i>Acacia nilotica</i> -0.3%
V-R-K-7	P-	<i>Xanthium strumarium</i> -56%
	S-	<i>Ageratum conyzoides</i> -30%
	I-	<i>Alternanthera sessilis</i> -8%, <i>Tridax procumbens</i> -5%
	M-	NIL

P = Predominant pollen type (>45%), S = Secondary pollen type (16-45%)

I = Important pollen type (3-16%), M = Minor pollen type (0-3%)

3) Herbs - *Capsicum frutescens*, *Croton banplandianum*, *Amaranthus viridis*, *Ageratum conyzoides*, *Celosia argentea*, *Imperata cylindrica*, *Coccinia grandis*, *Sida acuta*, *Alternanthera sessilis*, *Brassica nigra*, *Portulaca indica*, *Justicia procumbens*, *Vernonia cinerea*, *Celosia argentea*, *Evolvulus alsinoides*, *Tridax procumbens*. Of these three categories, trees and herbs served as major bee pasturage plants of *Apis florea* in this revenue division.

Unifloral honeys collected from Nelakondapalli and Viamsur Mandals are predominant with *Prosopis juliflora* and *Xanthium strumarium*. These two plants serve as chief bee pasturage plants of the Khammam revenue division. *Psidium guajava*, *Capsicum frutescens*, *Cajanus cajan*, *Phoenix sylvestris*, *Borassus flabellifer*, *Cocos nucifera*, *Citrus aurantifolia*, *Ricinus communis*, *Eucalyptus globulus*, and

Leucaena leucocephala are mainly from the agricultural tracts recorded from various honey samples. These plants serve as secondary or sometimes chief (in maximum blooming period) bee pasturage plants of this division. Some other herbs like *Ageratum conyzoides*, *Tridax procumbens*, *Evolvulus alsinoides*, *Justicia procumbens* and *Croton bonplandianum* grow along road sides or among weeds in agricultural lands and serve as other important bee pasturage plants of this division.

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REFERENCES

- ERDTMAN, G. (1960): The acetolysis method. A revised description. *Sven. Botan. Tidskr.* 54: 561-564.
 LOUVEAUX, J., A. MAURIZO & G. VORWOHI (1978): Methods of Melissopalynology. *Bee World* 59: 139-157.